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## FIELD OF THE INVENTION

The present invention relates generally to field of user interfaces for computer systems. More specifically, the present invention is directed to a  
5 method and an apparatus for combining the user interfaces of a plurality of applications.

## BACKGROUND

10 User interfaces refers to the methods and devices that are used to accommodate interaction between the machines and the users who use them. The user interfaces allow for communicating information from the machine to the user, and communicating information from the user to the machine.

Generally, the user interacts with the machine through the user interfaces  
15 presented by an application running on the machine. The user interfaces are designed by the software developers with the purpose of allowing the user to take full advantage of the functions of the applications. This may include presenting a finite number of options for the user to choose rather than requiring the user to memorize and manually enter commands from a large  
20 number of command options. Furthermore, the user interfaces are generally designed so that they are intuitive and easy to use. This significantly reduces the training to use a new application allowing the user to become productive in a short time.

Since the user may use applications designed by different groups of  
25 software developers from the different software vendors, the user is required to be familiar with multiple user interfaces and to interact with each interface



## SUMMARY OF THE INVENTION

In one embodiment, a method for combining the user interfaces of several applications is disclosed. Data generated by a first application is extracted from a display buffer. The data is associated with a user interface from the first application. From the extracted data, a layout pattern is recognized. Using the layout, an overlay is created. The overlay is used to display a second data generated by a second application. There is no direct link between the first application and the second application.

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## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example in the following drawings in which like references indicate similar elements. The following  
5 drawings disclose various embodiments of the present invention for purposes of illustration only and are not intended to limit the scope of the invention.

**Figure 1A** illustrates one embodiment of a computer system.

10 **Figure 1B** is an exemplary flow diagram of one embodiment of the melded user interfaces.

**Figure 2** is an exemplary web-based calendar manager illustrating a parent application.

15 **Figure 3A** is an exemplary layout of the calendar produced by an edge detection operation of a pattern recognition application.

**Figure 3B** is an exemplary layout produced by an edge smoothing  
20 operation.

**Figure 4A** is an exemplary layout with the boundaries identified.

**Figure 4B** is the same layout as in Figure 4A with the corners and  
25 intersections identified.

**Figure 4C** is the same lay out as in Figure 4B with the addition of the



## DETAILED DESCRIPTION

A method and apparatus for combining the user interfaces of several applications are disclosed. In the following description, for purposes of explanation, specific nomenclature is set forth to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that these specific details are not required in order to practice the present invention.

Some portions of the detailed descriptions that follow are presented in terms of algorithms and symbolic representations of operations on data bits within a computer memory. These algorithmic descriptions and representations are the means used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. An algorithm is here, and generally, conceived to be a self-consistent sequence of steps leading to a desired result. The steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like.

It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussion, it is appreciated that throughout the description, discussions utilizing terms such as "processing" or "computing" or "calculating" or "determining" or "displaying" or the like, refer to the action and processes of a computer system, or similar electronic computing

device, that manipulates and transforms data represented as physical  
(electronic) quantities within the computer system's registers and memories into  
other data similarly represented as physical quantities within the computer  
system memories or registers or other such information storage, transmission or  
5 display devices.

The present invention also relates to apparatus for performing the  
operations herein. This apparatus may be specially constructed for the required  
purposes, or it may comprise a general-purpose computer selectively activated  
or reconfigured by a computer program stored in the computer. Such a  
10 computer program may be stored in a computer readable storage medium, such  
as, but is not limited to, any type of disk including floppy disks, optical disks,  
CD-ROMs, and magnetic-optical disks, read-only memories (ROMs), random  
access memories (RAMs), EPROMs, EEPROMs, magnetic or optical cards, or  
any type of media suitable for storing electronic instructions, and each coupled  
15 to a computer system bus.

The algorithms and displays presented herein are not inherently related  
to any particular computer or other apparatus. Various general-purpose  
systems may be used with programs in accordance with the teachings herein, or  
it may prove convenient to construct more specialized apparatus to perform the  
20 required method steps. The required structure for a variety of these systems  
will appear from the description below. In addition, the present invention is not  
described with reference to any particular programming language. It will be  
appreciated that a variety of programming languages may be used to implement  
the teachings of the invention as described herein.

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## Overview

There is a need for a capability to allow the user interfaces of two or more applications to be combined or merged with one another. This capability allows  
5 for the free exchange of information between related applications and allows the context of a user interface from one application to be used by many different applications.

A method and apparatus for melding user interfaces are described.  
Melded user interfaces combines the user interfaces of two or more applications  
10 and does not require the cooperation or acquiescence from the applications (or their programmers). Using melded user interfaces, the screen layout (e.g., base layout) corresponding to the user interface of one application may be used by one or more other applications to display data associated with that application.

The application having the base layout is referred to herein as a parent  
15 application. The application whose data modifies the base layout of the parent application is referred to herein as a child application. There may be one or more children applications. The parent application provides the context for the displaying of the data from the children applications.

In one embodiment, an overlay generation mechanism (e.g., application)  
20 retrieves raster data associated with the user interface of the parent application from the display buffer of a personal computer video card. The raster data is used to determine a layout so that the child application can overlay the data it wants to display. In one embodiment, in order to make the correct overlay, previously compiled information about the layout of the user interface of the  
25 parent application is utilized. For example, when the parent application is an appointment application displaying appointment information in a monthly calendar view, the information that can be compiled from the display includes

data such as, for example, the location of the month name, the locations of the day names, the locations of the day numbers, etc. It will be appreciated to note that the parent application's user interface is designed and provided by the software vendor, independent of any child application. This independence of the parent application from the child application is advantageous because it allows a wide range of children applications to be used with the parent application.

**Figure 1A** is exemplary embodiment of a personal computer system that may be used to perform functionality described herein. The various components shown in **Figure 1A** are provided by way of example. Certain components of the computer in **Figure 1A** can be deleted from the addressing system for a particular implementation of the invention. The computer shown in **Figure 1A** may be any type of computer including a general-purpose computer.

**Figure 1A** illustrates a system bus 10 to which various components are coupled. A processor 15 performs the processing tasks required by the computer. Processor 15 may be any type of processing device capable of implementing the steps necessary to perform the operations discussed above. An input/output (I/O) device 20 is coupled to bus 10 and provides a mechanism for communicating with other devices coupled to the computer. A graphics display adapter 25 is connected to the bus to receive display data generated by the processor 15 and store the display data in a display buffer. A read-only memory (ROM) 30 and a random access memory (RAM) 35 are coupled to bus 10 and provide a storage mechanism for various data and information used by the computer, such as, for example, the overlay generation code and the pattern recognition code. Although ROM 30 and RAM 35 are shown coupled to bus 10, in alternate embodiments, ROM 30 and RAM 35 are

coupled directly to processor 15 or coupled to a dedicated memory bus (not shown).

A video display 40 is coupled to the graphics display adapter 25 and displays various information and data stored in the display buffer to the user of the computer. The data display may include the base layout of the parent application by itself or with the overlay display from the child application. A disk drive 45 is coupled to bus 10 and provides for the long-term mass storage of information. Disk drive 45 may be used to store the parent application, the child application, and the overlay generation application. It may also be used to store data associated with the parent and the child application. A keyboard 50 and a mouse 55 are provided to receive input from the user.

Initially, the parent application is the active application that controls the information displayed on the video display 40 before the child application is activated. In one embodiment, the child application runs in the background and is activated by pressing a key or a key combination on the PC keyboard 50. It will be apparent to one skilled in the art that other methods can be used to activate the child application, such as, for example, positioning the pointer of the mouse 55 on an icon representing the child application and pressing the left mouse button. When the child application is activated, the display buffer is read, the pattern recognition operation is applied, and the overlay layout is generated. The user can then interact with the data from the child application in the context of the user interface of the parent application.

In one embodiment, the child application continuously applies pattern recognition operations to the contents of the display buffer. When it detects the presence of a display format indicative of a known parent application, an indication of this event such as, for example, a beep or a flashing icon, is displayed to the user. This indication can be parameterized by the amount of

data the child can display in the current context of the parent. The user can then choose to invoke the child application in the manner described above. In another embodiment, the child application may be invoked automatically after a defined period of inactivity by the user.

5           **Figure 1B** is a flow diagram illustrating an exemplary embodiment of the present invention. At block 105, the raster data is read from the PC graphics card. The raster data is analyzed by a pattern recognition operation, as shown in block 110. The pattern recognition operation looks for patterns in the raster data to identify all or portions of a layout. In one embodiment, information  
10           previously compiled about the user interface of the parent application is utilized to identify and locate different sections of the layout, as shown in block 115. For example, when using a calendar display as the display from the parent application, the information about the calendar may comprise of the format of the calendar, the locations of the day names and the locations of the day  
15           numbers on the calendar. As another example, the display from the parent application is the window file system layout, and the information about the window file system may comprise the format of the file tree, the locations of the icons representing the directories, etc.

            The layout and the previously compiled information about the  
20           corresponding user interface are used by the overlay generation mechanism (e.g., application) to generate an overlay layout, as shown in block 120. In one embodiment, the overlay may comprise information from both the parent application and the child application. At block 125, the overlay is written into the display buffer and presented to the user through a display monitor.

25           At block 130, the user is able to interact with the child application through the melded user interface generated using the overlay. Using the layout of the parent application to display the data from the child application

provides the impression that both the parent application and the child application are integrated with one another. In one embodiment, the user of the parent application does not have to learn a new user interface to interact with the child application.

5 In one embodiment, when the child application is invoked, it writes data into the display buffer. The child application knows where (e.g., x, y pixel location) in the display buffer each data item was written. It also sets an event mask in the operating system that intercepts events from the user interface devices (e.g., keyboard, mouse, etc.). Such events typically include an  
10 identification of the event (e.g., identity of the key pressed, mouse button clicked, or x-y cursor position).

Based on a combination of event identity, its x-y location, and the locations of the child's data items, the event is either processed by the child application or it is processed by the operating system as it would normally be if  
15 the child application were not present. This allows the user to select the data displayed by the child application. For example, the user can move the mouse cursor on top of data items that were written in the display buffer by the child and click a mouse button to display another data item.

**Figure 2** is an exemplary calendar display that can be used with the  
20 present invention. The calendar display is from a web calendar manager which runs as the parent application. Information about the layout of the calendar display includes the knowledge that the calendar manager runs from within a web browser, and the calendar manager typically displays monthly calendar views, characterized by a rectangular grid layout with one grid cell used for  
25 each day of a month. Furthermore the month and year are displayed along the top center area 205, the names of the days are displayed in the first row 210,

centered above a calendar grid cell, and the day number of each day is displayed in the upper right corner 215 of each grid cell.

Using the knowledge about the parent application, the overlay generation application can generate its overlay on the layout of the parent application without altering the user interface of the parent application or  
5 causing the user to learn a new user interface.

In the calendar display example, the display from the calendar manager can be integrated with information from a child application, such as, for example, a document manager application. The document manager application  
10 retrieves documents previously generated and saved in a storage device. The overlay generation mechanism (e.g., application) uses the precompiled knowledge about the calendar manager (e.g., parent application) and generates an overlay for the documents retrieved by the document manager (e.g., child application) in the context of the parent application. For example, all documents  
15 to be reviewed by the user on September 15, 1999 are shown on the calendar display within the grid identifying the date September 15, 1999.

The pattern recognition operation detects whether the display buffer contains data representing a monthly calendar view. It finds out where the calendar is on the display and calculates the coordinates of the grid cell for each  
20 day. From the coordinates of the grid cells, a grid layout of the entire calendar can be generated. The pattern recognition operation is performed with a series of standard computer vision or image processing operation, which includes an edge detection operation. **Figure 3A** is an exemplary layout result produced by the edge detection operation. Note that the highlighted edges correspond to the  
25 edges shown in **Figure 2**. It will be apparent to one skilled in the art that other pattern recognition operations can be used to generate the grid layout without deviating from the invention.

The edges of the layout result shown in **Figure 3A** are filtered through a smoothing operation. This smoothing operation groups the pixels and connects the lines together. **Figure 3B** is an exemplary result produced by the smoothing operation. A line detection algorithm is then applied to locate the boundaries of the grid cells, as shown in **Figure 4A**. The line intersections and corners are identified using standard techniques, as shown in **Figure 4B**. This provides the grid for the calendar display.

The precompiled information about the calendar display is then used to estimate the locations of the day number, the day names, the months, and the year information in the grid of the calendar, as shown in **Figure 4C**. In one embodiment, optical character recognition (OCR) is applied to the raster data in these locations to obtain the day number, the month and the year displayed in the calendar. Contextual post-processing using knowledge about the calendar is applied to verify the character recognition results.

The overlay generation application uses the grid information and the knowledge about the locations of the day number, the day and the month to generate the overlay corresponding to the lay out of the parent application. **Figure 5A** illustrates an exemplary calendar parent application with the overlay information from the child application. In one embodiment, the document manager (i.e., child application) uses icons or thumbnail images to represent the documents. The physical location on the screen where the thumbnail images are placed is determined based on the grid cell locations and dates that were found by the pattern recognition operation. The document thumbnail images are then included in the overlay and displayed in the melded user interface.

In one embodiment, the user may dynamically adjust the size of the icons. In another embodiment, the overlay generation operation extracts the

first few pages of the documents and displays them in the melded user interface. Alternatively, the title or some other information indicative of the documents may be displayed instead of the thumbnail images or icons.

The overlay generation mechanism (e.g., application) may have to  
5 determine the locations of the data displayed by the parent application so that the placements of the thumbnail images from the child application do not overlap with the data from the parent application. In one embodiment, the overlay generation application may display the document thumbnail images on top of the data displayed by the parent application. The user may invoke the  
10 overlay mode by pressing a function key on the PC keyboard. This triggers the execution of the child application and displays the thumbnail images on the calendar.

**Figure 5B** illustrates an exemplary interaction with the child application through the melded user interfaces. Through the melded user interface, the user  
15 interacts with the child application by selecting the thumbnail images. Clicking on the thumbnail images 510 navigates the user to higher resolution documents represented by the thumbnail images. In one embodiment, the icons are also hotlinked to complete document descriptions 515 so that when the user places the cursor over the icon the complete description is displayed.

20 In one embodiment, the thumbnail images displayed in a grid cell show one or more documents that were recorded on that date. The display of the parent application and the child application can be toggled from one to the other. When the display from the child application is toggled on, the information from the parent application may be suppressed or overlapped by  
25 the information from the child application.





In another embodiment, the user interface can depend on the information provided by operating system. For example, with the web calendar as the parent application running in a browser, the child application may analyze the uniform resource locations (URL) associated with the web calendar application.

- 5 The URL may provide information that lets the child application know about the type of calendar view being displayed (e.g., week grid, month grid) without having to use the OCR. In another embodiment, both of the information from the registry and the OCR results may be used.

- In the foregoing discussion, the document manager application is used to
- 10 illustrate a child application overlaying the display of the calendar display parent application. Other children applications can also be used to take advantage of the present invention. For example, trip information, airline reservation information, and hotel confirmation information can be generated in the overlay by the overlay generation application using the display buffer. It
- 15 will be apparent to one skilled in the art that other applications can also be used as the parent application.

- Figure 6** illustrates an embodiment of a computer-readable medium 600 containing various sets of instructions, code sequences, configuration information, and other data used by a computer or other processing device. The
- 20 embodiment illustrated in **Figure 6** is suitable for use with the melded user interface method described above. The various information stored on medium 600 is used to perform various data processing operations. Computer-readable medium 600 is also referred to as a processor-readable medium. Computer-readable medium 600 can be any type of magnetic, optical, or electrical storage
- 25 medium including a diskette, magnetic tape, CD-ROM, memory device, or other storage medium.

Computer-readable medium 600 includes interface code 602 that controls the flow of information between various devices or components in the computer system. Interface code 602 may control the transfer of information within a device (e.g., between the processor and a memory device), or between an  
5 input/output port and a storage device. Additionally, interface code 602 may control the transfer of information from one device to another.

Computer-readable medium 600 also includes the overlay generation application 604 that is used to generate the overlay. Other codes stored on the computer-readable medium 600 may include the pattern recognition code 606,  
10 the edge smoothing code 608, and the optical character recognition code 612.

From the above description and drawings, it will be understood by those of ordinary skill in the art that the particular embodiments shown and described are for purposes of illustration only and are not intended to limit the scope of the invention. Those of ordinary skill in the art will recognize that the invention  
15 may be embodied in other specific forms without departing from its spirit or essential characteristics. References to details of particular embodiments are not intended to limit the scope of the claims.